CARNIVOROUS PLANT NEWSLETTER

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nal of the International Carnivorous Plant Society

Volume 31, No. 1 March 2002

CARNIVOROUS PLANT NEWSLETTER

Journal of the International Carnivorous Plant Society
www.carnivorousplants.org

Volume 31, Number 1
March 2002

Front Cover: New cultivar *Sarracenia* 'Triple Rarity', see article on page 18.

Back Cover: *U. ochroleuca* in Multopor Fen, Oregon, see article on page 4.

Carnivorous Plant Newsletter is dedicated to spreading knowledge and news related to carnivorous plants. Reader contributions are essential for this mission to be successful. Do not hesitate to contact the editors with information about your plants, conservation projects, field trips, or noteworthy events. Contributors should review the "Instructions to Authors" printed in the March issue of each year. Advertisers should contact the editors.Views expressed in this publication are those of the authors, not the editorial staff.

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Date of effective publication of the December 2001 issue of Carnivorous Plant Newsletter: 7 December 2001.

The ICPS is the International Cultivar Registration Authority (ICRA) for cultivated carnivorous plants according to The International Code For The Nomenclature of Cultivated Plants. Send relevant correspondence to the ICPS, Inc.

PUBLISHER: ICPS, Inc., Fullerton, California. Published quarterly with one volume annually. Desktop Publishing: Steve Baker, 5612 Creek Point Drive, Hickory, NC 28601. Printer: Kandid Litho. Logo and masthead art: Paul Milauskas. Dues: $25.00 annually. Reprints available by volume only © 2002 Carnivorous Plant Newsletter. All rights reserved. ISSN #0190-9215.

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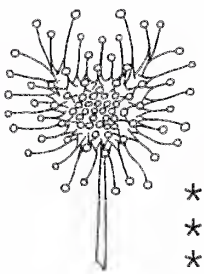
When in Northern California Visit



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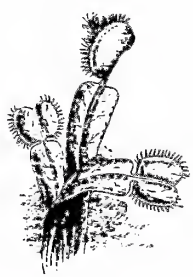

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The Search for *Utricularia ochroleuca* in Western North America

Hawkeye & Edith Rondeau • 37 Sunnyslope Avenue • San Jose, California 95127 • mybog@aol.com

Keywords: field studies: *Utricularia ochroleuca*, Canada (British Columbia), USA (California, Oregon, Washington).

Over the past two decades I have searched for the presence of this elusive species throughout the western United States and Canada. Initially, my only information came from Ceska & Bell (1973) who documented its current presence in the Oregon Cascade Mountains and its historical presence in Washington where it was initially classified as *U. occidentalis*. Additional information would later trickle in to support at least one extant Oregon site, but my inquiries and travel have failed to turn up much support for the Washington venues.

Using the site in the Oregon Cascades as a starting point, I set out in the late 1980s to expand the known range of this species. Having already seen the vast acres of bladderworts in the Bull Swamp just south of this area, I focused my initial searches from Clover Creek Road to Lake of the Woods, then northward to Four Mile Lake. After several visits to "The Bull" (as it came to be called) in sleet, hail, blazing sun or thunder and lightning, I was forced to conclude that it was home for a few leeches, many snakes, and thousands of mosquitos, but not for *U. ochroleuca*. However, this may not be the end of the story here; check back in five or ten years for an update.

After a few years in the Cascade fenlands my data, contacts, and wet spots were beginning to pile up. Places like Quaking Aspen Swamp, Torrey Lake, Cougar Reservoir, Detroit Lake, McKenzie Pass, Crater lake, and Government Camp beckoned with promise. And slowly over the years, Edith and I were able to visit many of these beautiful and occasionally obscure locations. Although many carnivorous plants were found along the way, we saw no new *U. ochroleuca* sites. Finally, in August of 1993, we found a new site in the shadow of the perennially snow-covered Mt. Hood (see Back Cover). Later in July 2000, another nearby site was documented. Certainly every wet spot in this area has potential for additional discoveries.

Final tally for Oregon after 15 years: 2 new sites.

My search for *U. ochroleuca* in California began with abundant early help from Joe Mazrimas, Larry Logoteta, Peter D'Amato, Rick Walker, Vernon Oswald, many local forest service botanists and native plant society field trip leaders. Also many silent hours were spent pouring over various carnivorous plant specimens in local herbaria in an effort to find some patterns of distribution, or perhaps some unique sites, that others may have overlooked. Armed with this new data, many good days were spent wandering through various wetlands from the southern Sierra Nevada to Goose Lake. But I must admit, I was not optimistic about finding this species in California. And I was painfully aware that one of our best former carnivorous plant sites had been radically altered by the creation of Lake Almanor in 1914. Several acres of *Drosera anglica* had been inundated, but there was still much water and ample shoreline remaining, and *Drosera rotundifolia* and *U. minor* had already been collected from the northern end of the lake.

We wandered northward from Highway 36 in June of 1994 with our frequent cohorts Bruce Bonar and Stephanie Changaris. Bald eagles and white pelicans flew overhead, and a lone sandhill crane stalked the cotton grass (*Eriophorum gracile*) plains. And down among the increasingly receding shoreline many bladderworts and water lilies (*Nuphar lutea* subsp. *polysepala*) were seen. But among the many yellow flowered emergents was one with a purple-green stem quite unlike all the rest: Stephanie and I stood transfixed by ankle deep mud and the unexpected *U. ochroleuca* plant! Göran Thor

would eventually help to confirm our identification.

Later, in July of 1998, Barry Meyers-Rice and Elizabeth Salvia would extend its range to nearby Willow Lake, which was already known to be home to *U. macrorhiza*, *U. minor*, and *U. intermedia*. In the smoke-filled September of 1999 (wildfires were all too common that year), I too plucked "something different" out of the muck of Willow Lake's northern shore; now this well-known site has four bladderwort species. This places the epicenter for *Utricularia* species richness in our state somewhere between Mt. Lassen and Sage Hen Creek near Truckee. If you wish to find more *U. ochroleuca* sites in Plumas County, you should probably start by following the water-course from Lake Almanor southward or visit the abundant wet spots in the Plumas-Lassen County neighborhood.

Final tally for California after 14 years: 2 new sites.

Elsewhere in the west, the apparent absence of *U. ochroleuca* in Washington persists. If only it were one-tenth as abundant as the *U. inflata* on Interstate 5, there would

California, Plumas County:

1. Northern end of Lake Almanor, east side of lake north of Hwy. 36 bridge, T29N-R7E-sw sec. 28, 1437 m., 24 June 1994, H. Rondeau 15169 (SJSU).
2. In shallows and on floating sphagnum mat at Willow Lake, 40°24'N, 121°21'W, 18 July 1998, B. Meyers-Rice & E. Salvia MR980701 (DAV).

Oregon, Lane County:

1. Gold Lake, approximately 3 km NE of Hwy 58 on FS Rd. 5897, RNA area is approximately 0.4 km SE of 5897, abundant in mossy area NW corner lake shore, no specimens found. Citations for this site: D.C. Ingram 2054, 24 August 1926 (Herb. of U. S. Forest Service), verified by A. Ceska in 1973; L. J. Dennis 2442, 2 September 1962; L. J. Dennis 2581, 24 July 1963 (verified by Ceska).

Oregon, Clackamas County:

1. Enid Lake, very small pond just N of Hwy. 26 & W of Government Camp access from Glacier View Rd.(#522 FS) 1300 m, no specimens found.
2. Multopor Fen, just SW of Government Camp in large meadow SW Hwy. 26, 45°17'21" N, 121°43'37" W, 1187 m., 23 July 2000, H. Rondeau, 195877 (OSC).

Washington, Klickitat County:

1. Various specimens collected in Falcon Valley, filed under *U. occidentalis* by W. Suksdorf between 1880 & 1923 at WS, WTU, CAN, & CAS.

Washington, Thurston County:

1. Also "...somewhere near Olympia...", Kincaid 24589 (WS) 1896 on sheet with *U. minor*.

British Columbia, Canada:

1. (Vancouver Island) Keta Lake, 51 km. from Woss, on Hwy. 19, 50°19'N, 126°02'W, 330 m., 22 July 1997 (as determined by A. Ceska) H. Rondeau 15172 (SJSU).
2. Blue Lakes complex: 59°50'N, 129°07'52"W, 906 m., on Hwy. 37 just south of Yukon Territory border; 23 July 1999, H. Rondeau 15175 (SJSU).
3. Liard River Hot Springs Provincial Park, 59°26'N, 126°06'W, Hwy 97, mile 496.5 AK Hwy, at south end of boardwalk, July 28 1997 H. Rondeau 15173, (SJSU).
4. Pools among *Larix laricina* islands at the right hand side of the boardwalk, where the boardwalk enters the forest. 59°25' 41.8"N, 126°05' 58.0"W (NAD 83) August 21, 2000, A. & O. Ceska 32187 (V).
5. "Tri-Lakes", S of Jack Fish Creek (~ 57 km. from Fort Nelson) & E. of Hwy. 97, 400 m., lakes appear to drain into Goguka Cr., 29 July 1997, H. Rondeau, 15174 (SJSU).

Table 1: All known collection sites for *U. ochroleuca* in California, Oregon, Washington, and British Columbia. (Herbarium citations are listed when available)

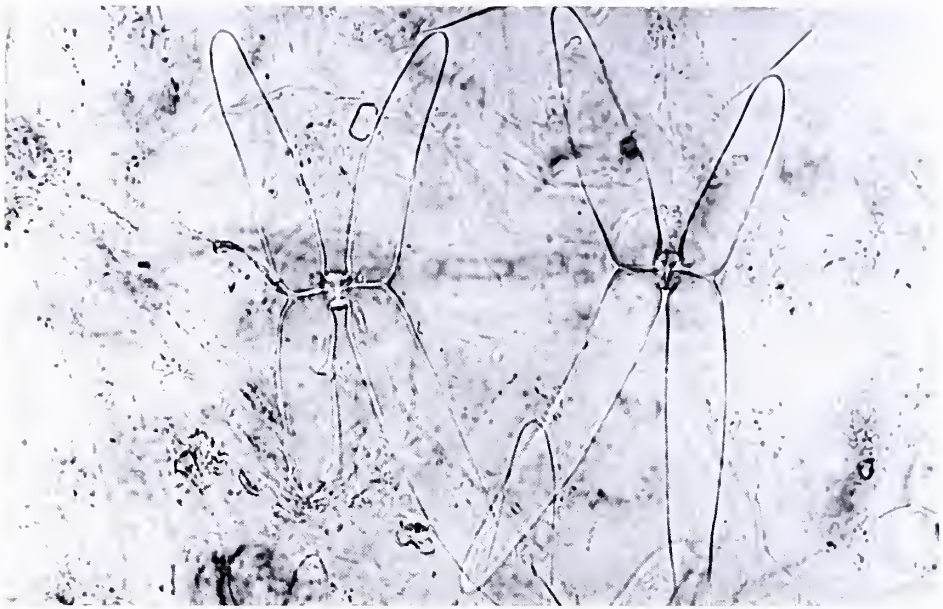

Figure 1: *U. ochroleuca* internal quadrifid glands, 200x. Photograph by Don Schnell.

be so much more to report. Perhaps next year the secrets of Wilhelm Suksdorf's collections (Webber, 1942) in southern Washington will be revealed, but for now his discoveries remain hidden in the shadows of Mt. Adams.

Of course, while all of the above was going on, Edith and I also continued to range increasingly farther north into that portion of the vast Canadian sponge known as British Columbia. About 4% of its land mass is said to be composed of various wetlands, but a quick trip across Vancouver Island on Highway 19 or northward from Prince Rupert on Highway 37 gives the distinct impression of an even greater abundance. But despite this extensive prospective habitat, *U. ochroleuca* was reported here only once and that was over fifty years ago (Porsild, 1951; Boivin, 1966). Curiously, my awareness of its presence here came about only by accident: a copy of the reference to the site (Porsild, 1951) came to me in the mail as a gift, and I had somehow forgotten that Ceska and Bell (1973) had refuted this identification by saying "...So far we have seen no specimen of *U. ochroleuca* from British Columbia."

And so it was in 1997 that I found myself at that previously reported site: Liard River Hot Springs Provincial Park in the middle of a sixteen day-8000 kilometer trip in

California, Plumas County:
1. Butt Valley Reservoir.

Oregon, central Cascade mountains area:
1. Three-Sisters Wilderness.
2. Many Lakes Research Natural Area.

Washington, Klickitat County:
1. Conboy National Wildlife Refuge, formerly referred to as "Falcon Valley".

British Columbia, Canada:
1. Log Cabin (59°46'N, 134°58'W; 1000 m.) between Carcross & Skagway, many small ponds along Hwy. 2.
2. Bonus Lake, Hwy. 37, N of Cranberry Jct. (55°36'N, 128°37'W).

Table 2: Probable sites for *U. ochroleuca* in California, Oregon, Washington, and British Columbia.

northern BC (I had already found a potential *U. ochroleuca* site on Vancouver Island). After a thorough reading of Reid's master's thesis (1978) on the vegetation and ecology of this area, it featured prominently on my itinerary. Surely any carnivorous plant enthusiast or botanist would want to wander among these warm (maximum temperatures ranging to nearly 54°C (130°F)) and abundant waters dotted with *Pinguicula cf. vulgaris* (not in flower), *Drosera anglica, Triglochin* spp., *Parnassia palustris*, *Oxycoccus microcarpus*, *Spiranthes romanzoffiana*, and *Orchis rotundifolia*. But Reid only noted *U. intermedia* and *U. vulgaris* (*macrorhiza*) on his species list; fortunately, I had seen Porsild's report from 1951.

A quick glance across the open waters revealed no yellow flags. Obviously if the bladderworts were not coming up to meet me, I would have to go down to find them. So into the muck I went, and after processing one or two handfuls of aquatic vegetation while dodging the resident alpha moose, *Voila*! *U. ochroleuca* was found once more at Liard River Hot Springs. But sadly, although I often speak of British Columbia as being a "beary" nice place to visit, about three weeks later two people from Texas would be killed by a black bear (*Ursus americanus*) very near this same spot. Certainly I was aware of the history of bear attacks here, but I had expected any threats would come from the larger and often less predictable grizzly bear (*Ursus horribilis*).

After this dalliance in the hot springs it was getting late, and I needed to push steadily southward. I planned to travel only as far as Muncho Lake Provincial Park to see a few stone sheep (*Ovis dalli*), more carnivorous plants and orchids, and then a bit further on to Fort Nelson—home of *Sarracenia purpurea* (a rarity this far west). However, chaos has intruded between my data and the realities of the landscape: the center of the town had been moved; the main road through town had been moved; most, if not all, of my reference points had been shifted or obliterated completely. Parker Lake, was said to be home to pitcher plants, but just where was it relative to Highway 97 now?

Slowly a miraculous vision replaced my consternation: the areas near Fort Nelson looked a lot like the New Jersey pine barrens. Ergo, one might find pitcher plants almost anywhere (later I learned from Randy Lamb that there was some truth to this). So dash the map, road, or whatever that wasn't where it was supposed to be—I was in full bush-whack-serendip mode.

If you have ever tried finding carnivorous plants this way, you can guess what happened. We saw no pitcher plants. However, we did find more *U. ochroleuca* sites several miles south of Fort Nelson. And this foray into the bush included the first time I have ever been threatened by a winged assailant while searching for carnivorous plants. Yes, I was repeatedly dive-bombed by a Bonaparte's gull that was intent upon keeping me away from its young chick in a nearby unnamed lake while I was searching for carnivorous plants.

Final tally for British Columbia after 11 years: 5 new sites.

Please join me again next time for another bladderwort excursion to the Blue Lakes drive-in in western British Columbia—perhaps the largest bog-lake complex in the entire province!

Acknowledgments

Many persons have already been noted in text or in references, but the following should also be credited for there are no small contributions in field biology.

California: Ron Coleman, Leon Glicenstein, Ed Read, Ivan Snyder, Barry Meyers-Rice, Chris Meacham, David O. Gray.

Oregon: Kenton Chambers, John Christy, Jenny Dimling, Don Eastman, Richard Halse, Don Graham, Veva Stansell, Rhoda Love, Sarah Malaby, Reid Schuller, Bruce Newhouse, Andrea Raven, David Wagner, Mike McKeag.

Washington: David Biek, Nelsa Buckingham, Sarah Gage, Art Kruckeberg, Tom Kahl, Laura Potash, Kevin Snively, Andrew Marshall, Sandy Swope Moody, Kathy Hamel.

British Columbia: Adolf Ceska, Karen Golinski, Tim Malcolm, Malcolm Martin, Jill Peterson, Hans Roemer, Beth Rogers, Chris Teichreb, Patrick Warrington, Patrick

Williston, Doug Fung.

Yukon Territory: Bruce Bennett, Randy Lamb.

With special thanks to Natalie Hopkins and Toni Corelli at the San Jose State University herbarium; Wayne Savage for sharing his insightful knowledge of the SEM; Don Schnell for his abundant contributions; Lubomir Adamec, Bill Cody, Göran Thor, and Peter Taylor for international assistance.

Note from the editors: It is policy that articles in Carnivorous Plant Newsletter do not include precise location data for endangered species. While *Utricularia ochroleuca* is rare in the region H. Rondeau discusses, it is not a globally rare species so we do not feel the location data in this article represents a significant danger to the species. (BMR)

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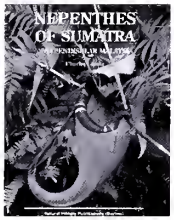
Book Review



Clarke, C. 2001. *Nepenthes* of Sumatra and Peninsular Malaysia. Natural History Publications (Borneo), Kota Kinabalu, Sabah, Malaysia. ISBN 983-812-050-2. 326 pp. + x, 12 tables, 157 figures (most of which are high quality colour photographs), 34 distribution maps (31 dot, 3 generalized area outline), approximately $US80.

Reviewed by Jan Schlauer

This book is different, and to make a long story short, I like it and I recommend it without any reservation. It marks a significant and most welcome deviation from the contemporary trend of "quick and dirty" approaches in both popular and scientific literature. Even highly controversial taxonomic issues are covered in a diplomatic yet explicit way, so no opinion was entirely ignored.

The book is divided into the chapters "Nepenthes, Sumatra, and the Malay Peninsula" (27 pp.), "Ecology" (46 pp.), "The Species" (133 pp.), "Natural Hybrids" (3 pp.), "Conservation" (15 pp.), "Cultivation" (19 pp.), and a list of references (15 pp.), glossaries, three appendices with additional data, acknowledgements, and indices.

The author has achieved a remarkable goal, viz. to study almost all species of *Nepenthes* occurring in the title area in situ, to review their taxonomy, to gather new insights in their ecology, and to present all this valuable information in a concise but entertaining form, accompanied by pictures of unprecedented quality and beauty. Although the author was well prepared by the research for his first milestone, "*Nepenthes* of Borneo" (1997), it is difficult to believe his new book was possible within only four years (only 6 species are widespread enough to occur in both areas!).

What puzzles me most is the fact that there are almost no obvious mistakes in the text (there are probably more typos in this review than in the whole book!). The northernmost limit of *Nepenthes* is in the Khasi Hills, India—*N. khasiana* being the only "extratropical" species in the genus—and not in southern China. Queensland, Australia, is usually not considered a part of Asia, and the southernmost limit in Australasia is New Caledonia and not Queensland (all on p. 12). In the legend of Fig. 6 (p. 13) the expressions "dark blue" and "light blue" are swapped, so the text becomes a little confusing. The list of examined specimens is only a selection but understandable space limitations were probably effective here.

One new species, *N. jacquelineae*, is described and this is also one of the most spectacular species in the genus (we are not really surprised, are we?). "The closest relatives (...) appear to be *N. inermis*, *N. tenuis*, and *N. talangensis*, but it is more robust than any of these. (...) The peristome is unlike that of any other species, being very broad and horizontal, with scarcely discernible ribs , except at the front. The enormous nectar glands on the lower surface of the lid also appear to be unique among the Sumatran species." (p. 151)

With this book in hand we know what was missing, and despite reluctance indicated by the author (pers. comm.), all efforts should be made to continue along the outlined trail. Charles, we look forward to seeing "*Nepenthes* of the Philippines and East Malesia"!

Erratum

A line of header text, "*Sarracenia* 'Golden-Red Jubilee' " was accidentally dropped from the top of page 115 in the December 2001 issue of Carnivorous Plant Newsletter.

CONRAD GESSNER AND *PINGUICULA*—A NEARLY FORGOTTEN ASPECT OF THE PRE-LINNEAN HISTORY OF LENTIBULARIACEAE AND *PINGUICULA* L.

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Keywords: History: Lentibulariaceae, *Pinguicula*, Conrad Gessner.

Conrad Gessner (1516-1565), born in and citizen of Zürich (Switzerland), physician by profession, famous philologist, "father of the bibliography," and one of the most important scientists in natural history in the sixteenth century (Fischer, 1966), seems to be the first who introduced the butterwort under the modern name *Pinguicula* into botany (Casper, 1962, 1966).

Specialists know that Gessner planned an extensive "*Historia plantarum*" in the same format as his "*Historia animalium*" (1551-1558). In his "*De Hortis Germaniae*" (1561) he wrote, enchanted by enthusiasm and delight, that he would create a work on the whole world of plants in natural order. In the last five years of his life he was engaged intensively on this subject, collected and exchanged relevant material, cultivated plants, and was in correspondence with many botanists (Steiger, 1968). An inspired mountaineer, he went whenever possible on mountain or alpine excursions to study the landscape, animals and especially plants.

Figure 1: Copy of the facsimile of *Scutellaria galericulata* L. and *Utricularia australis* R. Brown. —Reproduced with permission of the University Library of Erlangen (Germany), Department of Manuscripts.

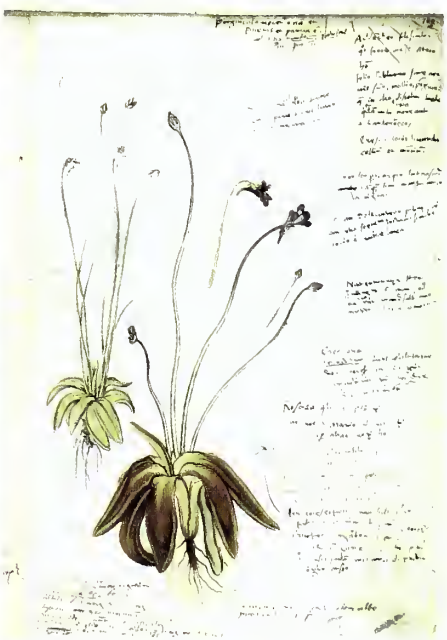

Figure 2: Copy of the facsimile of *Pinguicula vulgaris* L. and *Pinguicula alpina* L. —Reproduced with permission of the University Library of Erlangen (Germany), Department of Manuscripts.

Unfortunately Gessner did not complete his "*Historia plantarum*" in his lifetime. About 200 years passed before Schmidel (1754-1771) published an incomplete set of Gessner's work, relying upon the "*fragmenta relicta*," Later, Milt (1929, 1936) discovered volumes in the University Library of Erlangen (Bavaria), which were believed lost—these contained about 1,500 original paintings with annotations, many of which were written by Gessner himself. In 1991, Zoller and Steinmann finished the complete edition ("Gesamtausgabe") of "*Conradi Gessneri Historia Plantarum*" in two volumes containing the reproduction which included sixteen facsimiles and 838 reduced coloured water-colours of the manuscript.

But what about the names Lentibulariaceae and *Pinguicula*? Conrad Gessner is the originator of both.

The name of the family Lentibulariaceae is derived from the Latin (*lens* = lentil and *bulla* = bladder) and first appears as "*Lentibullia, vel* Lentibullaria" on Gessner's annotation on his original painting of *Utricularia australis* R. Brown (see Figures 1, 3; from University Library of Erlangen, Ms 2386, *fol.* 206b; copy: Zentralbibliothek Zürich Ms Z VIII 394a No 222 (sub *Utricularia neglecta* Lehm.); Steiger, 1968: 50/51; Zoller & Steinmann, 1991: 82/83 (erroneously printed "85"), Taf. 7, *fol.* 206 *verso*). The proposed name faded away as a denomination of the species perhaps because of the incompleteness of Gessner's "*Historia plantarum*", although it persists in slightly corrupted form as the name of the whole plant family (Casper, 1974). The interpretations given by Wittstein (1856: 509, erroneously from lat. "*lens*" and "*tubulum*") and Genaust (1996: 332, erroneously from lat. "*lentibulum*") are insufficient or incorrect.

It should be mentioned that the figure of *Utricularia australis* is the best one ever

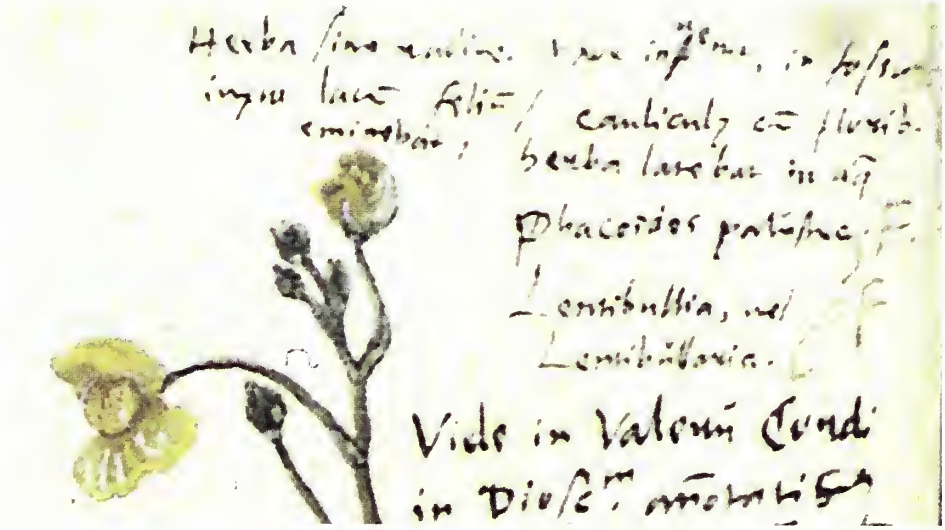

Figure 3: Detail from the upper right corner of Figure 1. Note the phrases "*Lentibullia*" and "*Lentibullaria*".

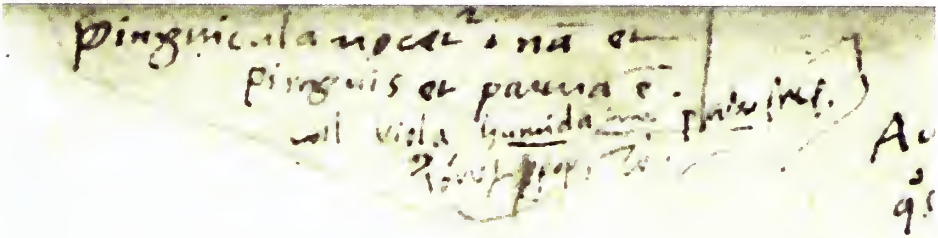

Figure 4: Detail from the upper right corner of Figure 2. Note the phrase "*Pinguicula vocit*[*ur*], *na* [*am*] *et pinguis et parva* e [*est*]".

published. The carnivorous water plant was collected by Gessner's wife in the ditches flowing to the Katzensee near Zürich.

The name of the genus *Pinguicula* is derived from the Latin (*pinguis,e* = fat), as Gessner wrote on his original watercolour (see Figures 2, 4; from University Library of Erlangen Ms 2386, fol. 128; Fischer 1966: 100, Fig. 26; Zoller & Steinmann, 1991: 47, *fol.* 128 *recto*): "*Pinguicula vocit*r[*ur*], *na*[*am*] *et pinguis et parva e*[*est*]" ("named *Pinguicula* because it is as fat as small").

On August 20-21, 1555 (and also, later in 1556) he ascended Mount Fractus ("Mons Fractus" in Latin, or "Fraktenmunt" in Swiss German, because of its two summits; the Swiss now refer to the mountain using the name Pilatus). Mount Fractus was a landmark mountain for Lucerne (a "Hausberg"), and as was customary he sought permission from the local authorities to climb it. He obtained the "*venia montem Fractum ascendendi*" ("permission to go on the Fraktenmunt") from the mayor of the city, Nikolaus von Meggen. Accompanied by three friends, the stone-cutter Petrus Figul, the pharmacologist Petrus Boutin, and the glass-painter Johannes Thoma(nn) he reached the summit and passed the night in a haystack. Soon after, in September 1555, he published a booklet in Zürich—the so-called "Lunarien"—under the title "*De raris et admirandis herbis, quae sive quod noctu luceant, sive alias ob causas Lunariae nominantur....*" ("Of rare and admirable plants, which might either shine at night or may be called lunaries for other reasons...") with the attachment "*...Descriptio Montis Fracti sive Pilati, ut vulgo nominat juxta Lucernam in Helvetia.*"

In this "Description of the Fraktenmunt or Pilatus, as it is called, near Lucerne in Switzerland" he listed on pages 63-66 all the alpine plants known to him and gave the first descriptions of the mountain vegetation according to their zonal occurrences. On page 63 he mentions "*Pinguicula, ut ficto a nobis nomine appellatur*" ("*Pinguicula* as it is called with a name given by us"). He wrote it had a blue non-fragrant flower like the March violet, its leaves were fat, smooth and nerveless as in "*Lingulaea vel ophioglossus*" (i.e. *Ophioglossum vulgatum*) and it grew in damp places ("*in palustribus*"). This short description is in good agreement with the figure mentioned above, which seems not to be from the Pilatus nor from Gessner's hand with the exception of the two detail drawings of an inflorescence and flower and fruit (Zoller & Steinmann, 1991: 47). The picture and description portray *Pinguicula vulgaris* L., which in the pre-Linnean era was named *Pinguicula Gesneri* (Clusius 1583: 361).

On the left side of *fol.* 128 *verso* a second *Pinguicula* with white flowers is figured which is said to be from Gessner's hand (Zoller & Steinmann, 1991: 47). He remarks: "*Repi*[*eri*] *etiâ*[*am*] *albo flore semel: parte floris lutea intus, et hirsuta, etc.*" ("Once I found one with a white flower, with the interior part of the flower yellow and hairy"). This is without a doubt *Pinguicula alpina* L.

Later, in his "*De Hortis Germaniae*" (Gessner 1561: 272b) he mentioned *Pinguicula* again adding without any explanation the second name *Liparis* which soon disappeared in the literature of the genus but was kept alive as a name for the orchid *Liparis* Rich.

Acknowledgement

I heartily thank Dr. Hofmann-Randall, Universitätsbibliothek Erlangen, Handschriftenabteilung, for the reproduction of the valuable original paintings and the permission for publication.

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Literature Reviews

Meimberg, H., Wistuba, A., Dittrich, P. & Heubl, G. 2001, Molecular Phylogeny of Nepenthaceae Based on Cladistic Analysis of Plastid trnK Intron Sequence Data. Plant Biol. 3: 164-175.

Based on genetic data, the monophyly of Nepenthaceae is demonstrated. *Nepenthes pervillei* (Seychelles) and *N. distillatoria* (Sri Lanka) appear to be the most basal species (they form sister clades to the rest of the genus). The next basalmost branch is formed by the pair *N. masoalensis/N. madagascariensis* (both Madagascar), and within the remaining genus *N. khasiana* (northeast India) is the first branch. Thus the hypothesis is supported that the five "western" species are the most primitive within the genus. Most of the remaining species form clades that indicate close affinities between species that occupy overlapping or neighbouring ranges. This possibly hints at comparatively recent sympatric speciation or at ongoing hybridization and introgression in this apparently more derived part of the genus.

Zamudio Ruiz, S. & Studnicka, M. 2000, Nueva Especie Gipsicola de *Pinguicula* (Lentibulariaceae) del Estado de Oaxaca, Mexico. Acta Bot. Mex. 53: 67-74. (A New Gypsicolous Species of *Pinguicula* (Lentibulariaceae) from the State of Oaxaca, Mexico; in Spanish)

Pinguicula medusina is the name validated here of what has been known as "*Pinguicula* alfredae" (an illegitimate name never published with a formal description) in cultivation for decades. So far the plant is known in the wild only at its type locality. Several differences between this and the closely related, widespread and quite variable *P. heterophylla* are given (flowers smaller and narrower, upper corolla lobes less reflexed, lower corolla lobes narrower and more truncate, corolla paler, flowering time and winter rosette formation later, fewer leaves in *P. medusina*). A quite generalized picture of *P. heterophylla* is thus drawn, and it is open to debate if the given characteristics reliably separate two distinct species throughout the wide geographical range (and the considerable morphological range) of *P. heterophylla s. lat.*

Ecological Differences Between *Utricularia ochroleuca* and *U. intermedia* Habitats

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Keywords: field studies: Czech Republic, *Utricularia ochroleuca, U. intermedia.*

Introduction

Utricularia ochroleuca R. Hartm. and *U. intermedia* Hayne (Lentibulariaceae) are rootless, aquatic to amphibious carnivorous plants with distinctly dimorphic shoots (*e.g.* Thor, 1988). Their green, more or less horizontal, photosynthetic shoots bear at most only a few traps, while their usually colourless carnivorous shoots bear numerous traps and are immersed deeply in a loose substrate. Morphologically, the species closely resemble each other, and their habitats are very similar. These two species can be distinguished by both floral and quadrifid gland characters.[1] They grow in shallow, standing, dystrophic waters, in fen lakes, bogs, and peaty fishponds. However, at least in central Europe they very rarely occur in the same wetland. In spite of an examination of the phytosociological characteristics of these two species (Pietsch, 1977), no evident differences have been found between *Utricularia ochroleuca* and *U. intermedia* in ecological factors in their respective stands. Generally, both species show a rather wide ecological tolerance of many factors (Pietsch, 1977), and their ecological limits greatly overlap (Kosiba and Sarosiek, 1989; Kosiba, 1993). This suggests that these species are able to grow together. In the Czech Republic, both species are considered Critically Endangered (Red Data Book of the Czech flora, 1999). The Trebon region in S Bohemia is the centre of their recent distribution in the Czech Republic. Here, twelve sites of *U. ochroleuca* and eight sites of *U. intermedia* have been verified during the 1990s (L. Adamec, unpubl.). As few as fifty shoot apices, to as many as one million shoot apices occur at each site (estimating from typical shoot number density and population area).

The aim of this study was to measure physical and chemical habitat factors in dominant stands of *U. ochroleuca* and *U. intermedia* in the Trebon region and to define possible ecological differences between the habitats of these species. Attention was also paid to the maximum stand biomass of these species and the length of their carnivorous shoots.

Material and Methods

On 16-23 July 1996, ecological factors were investigated at eight sites of *U. ochroleuca* and five sites of *U. intermedia* in the Trebon Basin Biosphere Reserve and Protected Landscape Area, South Bohemia, Czech Republic (approximately 49°N, 14°45'E). The sites were peat bogs, usually in the littorals of eutrophic fishponds.

[1]The species *U. stygia* Thor may also occur in the area of this study—indeed, all records of "*U. ochroleuca*" from neighbouring South Germany have been revised as *U. stygia*. Further study is needed to determine if the *U. ochroleuca* reported in this study consists partly or completely of *U. stygia*.

Relatively dense stands of both *Utricularia* species were selected at each site for measuring the physical and chemical factors and for water sampling.

The dissolved O_2 concentration and pH were measured between 9:00 and 17:00 local summer time in the zone surrounding the photosynthetic *Utricularia* shoots. Filtered water samples were collected. Total alkalinity (TA) was estimated by end-point titration (pH 4.40). The CO_2 concentration was calculated from TA and pH. NH_4^+-N, K^+, Na^+, Ca^{2+}, and Mg^{2+} concentrations were estimated in the water samples (for all analytical details see Adamec, 1999). The concentration of humic acids + tannins was estimated using a modification of a standard colorimetric method (Adamec & Lev, 1999). An estimate of the level of shading of the water surface by emergent vegetation was made in *Utricularia* stands using a sensor which measured photosynthetically active radiation (PAR; 400-700 nm; Adamec, 1999). The results are expressed as percentages of incident PAR reaching the water surface. Six parallel PAR estimates were conducted in one investigated stand in order to compensate for variation between measurements. Generally, at most of the sites investigated, physical and chemical factors were measured in two different *Utricularia* stands within the same pool or swamp. In such instances, means of the two values for each variable were used for statistical analyses. The values measured in different (usually distantly separated) isolated pools within a site were used as independent data.

In order to evaluate the possibility of the role of both *Utricularia* species in mineral nutrient cycling in these habitats, the biomass of *U. ochroleuca* and *U. intermedia* was harvested in two parallel harvests at the largest sites in dense stands from an area of 0.25 m^2. Both photosynthetic and carnivorous shoots were collected and pooled. *U. ochroleuca* was harvested at three sites and *U. intermedia* at three other sites. The plant biomass harvested was thoroughly washed with tap water and the lengths of ten randomly selected intact carnivorous shoots were measured in each harvest. This was used to estimate the substrate depth which these shoots can reach. Dry weight (DW; 80°C) of total biomass was estimated.

Physical and chemical factors in the habitats which may have differed between the two species were statistically tested by non-parametric Mann-Whitney two-sample t-test as some data sets did not have a normal distribution. Only the probability level $p=0.01$ was accepted as statistically significant, because of the very low number of data ($n=11$ in *U. ochroleuca*; $n=5$-6 in *U. intermedia*), while $p=0.05$ was considered as weakly significant.

Results and Discussion

As shown in Table 1 the values for most physical and chemical factors in the different stands greatly overlap between the sites of *U. ochroleuca* and *U. intermedia*. Oxygen concentration at the level of photosynthetic shoots always exceeded 2.0 mg l^{-1}. Thus, these shoots cannot have suffered from O_2 shortage, but this should not be true for the carnivorous shoots. *U. ochroleuca* was found to grow within a wide pH range of 5.5 to 8.8, while *U. intermedia* grew in stands with pH 4.9 to 6.6. Pietsch (1977) reported pH limits between 4.1 and 8.5 for hundreds of European sites of *U. intermedia*, with the most common values falling between 6.1 and 7.0. Very high free CO_2 concentrations, up to 6.5 mM, were usually found in water in the stands of both *Utricularia* species. Such high CO_2 concentrations were also found at *Aldrovanda vesiculosa* sites in Poland (Adamec, 1997) and are typical of shallow dystrophic habitats of the majority of temperate aquatic carnivorous plants. High $[CO_2]$ may be important for rapid growth of aquatic *Utricularia* species since probably all these species can only use free CO_2 for photosynthesis (Adamec, 1997). However, of the two species, only *U.*

ochroleuca can tolerate, at least temporarily, higher pH >8 and, thus, relatively low [CO_2] (Table 1).

	Utricularia ochroleuca				*Utricularia intermedia*				Statist.
Parameter	Mean	Med.	Range	SE	Mean	Med.	Range	SE	signif.
O_2 [mg l^{-1}]	6.4	5.4	2.0-12.7	1.0	5.3	4.5	3.2-8.0	0.7	NS
pH	6.07	6.32	5.48-8.77	—	5.41	5.93	4.85-6.62	—	NS
TA [meq.l^{-1}]	1.07	0.99	0.15-2.55	0.2	1.02	0.86	0.27-1.89	0.33	NS
CO_2 [mM]	1.58	1.16	0.02-4.88	0.49	2.28	1.12	1.00-6.51	1.07	NS
NH_4-N [mg l^{-1}]	29	24	0-225	10	77	51	2-237	33	*
K [mg l^{-1}]	7.2	7.6	1.9-14.5	1.3	1.0	1.2	0.4-1.8	0.2	**
Na [mg l^{-1}]	7.4	7.5	4.2-8.9	0.4	5.8	5.6	4.0-8.3	0.7	NS
Ca [mg l^{-1}]	23.1	23.5	4.8-31.8	2.3	13.7	13.6	8.1-19.4	2.2	*
Mg [mg l^{-1}]	5.8	5.5	1.0-11.2	2.7	3.1	2.8	1.8-5.9	0.7	*
HA+T [mg l^{-1}]	15.4	12.6	4.3-35.6	2.7	23.8	18.1	10.5-58.7	8.8	NS
PAR [%]	25	14	2-100	8	10	9	2-29	3	*

Table 1: Physical and chemical factors at *U. ochroleuca* and *U. intermedia* sites. TA, total alkalinity; HA+T, sum of concentrations of humic acids and tannins; PAR, mean level of shading on the water surface in stands; med., median. NS, not significant; * $p<0.05$; ** $p<0.01$

Median NH_4^+-N concentration in *U. ochroleuca* stands was about one half of that found in *U. intermedia* stands (24 vs. 51 mg l^{-1}), but this difference was not statistically significant at p=0.01 (Table 1). On the basis of NH_4^+-N concentrations, the waters within these stands may be characterized as mesotrophic, though many of them are adjacent to hypertrophic fishponds. However, both species can tolerate much higher NH_4^+-N concentrations (3.2 to 9.4 mg l^{-1}) as found by Kosiba and Sarosiek (1989) and Kosiba (1993) at anthropogenically influenced sites in Lower Silesia, Poland. In our results concerning all factors measured, these two species differed significantly only in terms of K^+ concentrations found in the water in which they occurred (Table 1). *U. ochroleuca* preferred waters with higher [K^+]. Nevertheless, Kosiba and Sarosiek (1989) and Kosiba (1993) found both species in waters with extremely low [K^+], 0.01 to 0.3 mg l^{-1}. In such waters, K^+ uptake from prey might be crucial for the growth of the plants. In the Trebon region, *U. ochroleuca* occurred in waters with higher [Ca^{2+}] and [Mg^{2+}] than were the concentrations in waters with *U. intermedia* (Table 1). However, this difference was only weakly significant and the values overlapped to a large extent. Similarly, Pietsch (1977) reported on the European occurrence of *U. intermedia* in waters with a very wide range of [Ca^{2+}], between <1 and >30 mg l^{-1}. The most common values fell between 1 and 25 mg l^{-1}. Both species were found in waters with variable concentrations of humic acids and tannins. However, *U. intermedia* probably tolerates more dystrophic (darker) waters (Table 1).

These two species of bladderwort differed considerably with respect to the level of shading of the water surface by emergent vegetation at their respective sites, but this difference was significant only at p=0.05. It follows from the data that *U. ochroleuca* is highly tolerant of PAR irradiance level and can grow in deep shade (ca. 2 % of incident PAR) as well as in full sunlight (100 % PAR), with an optimum of about 15 to 30 % PAR. On the other hand, *U. intermedia* prefers more shaded microhabitats with an optimum of only about 8 to 12 % PAR; *i.e.*, it is a facultative sciophyte which grows in full sunlight on rare occasion. But the main difference in light

requirements between the two species is based on the fact that *U. ochroleuca* often grows over wet peaty soils in a terrestrial ecophase in full sunlight. In such instances, the plants acquire a red-yellow or rose coloring. In contrast, *U. intermedia* can only grow as submerged plant in full sunlight, and in this case its shoots are yellow-green or slightly reddish.

Relatively low total biomass of both *Utricularia* species was found even in their densest stands. Mean DW of *U. ochroleuca* was 15.2 (range 6.1 to 22.1) g m^{-2}, and a similar value of 16.6 (range 9.7 to 23.6) g m^{-2} was recorded for *U. intermedia*. The mean biomass in dense stands of both *Utricularia* species was comparable with the values reported by Kosiba and Sarosiek (1993) for *U. vulgaris* (mean DW 16.8 g m^{-2}), *U. australis* (DW 8.6 g m^{-2}), and *U. minor* (DW 6.0 g m^{-2}) stands at sites in Lower Silesia, Poland. Thus, the mean dry biomass of European aquatic *Utricularia* species at the peak of the vegetation season is by one to two orders of magnitude lower than that of other aquatic plants (cf. Pokorn? and Ondok, 1991). The most common dominant plants at *U. ochroleuca* sites were *Carex rostrata, Phragmites australis, Carex gracilis, Sphagnum* sp., *Calamagrostis canescens, Eriophorum vaginatum,* and *Juncus effusus*, while at *U. intermedia* sites, they were *Phragmites australis, Eriophorum vaginatum,* and *Comarum palustre.*

The mean length of carnivorous shoots of *U. ochroleuca* was 6.1 cm (range 2.0 to 14.1 cm; SE 0.34 cm; n=60) and that of *U. intermedia* was 6.7 cm (range 2.0 to 17.6 cm; SE 1.0 cm; n=60). Plants of the former species bore on average 1.93 carnivorous shoots and those of the latter species did 1.95 carnivorous shoots. It follows from the data recorded that carnivorous shoots of both species could reach ca. 13-15 cm deep to a loose substrate in which hypoxia or anoxia could occur.

Conclusions

Ecological differences were investigated in *Utricularia ochroleuca* and *U. intermedia* populations in the Trebon Basin Biosphere Reserve, Czech Republic. Out of all eleven factors investigated, only $[K^+]$ in the aqueous environment was found to be significantly different ($p=0.01$) between the habitats of these two species; the other factors ($[NH_4^+\text{-N}]$, $[Ca^{2+}]$, $[Mg^{2+}]$, and level of shading) were different only at a weakly significant ($p=0.05$) level or were non-significant. *U. ochroleuca* preferred microsites with higher pH, lower $[CO_2]$ and ($[NH_4^+\text{-N}]$, and higher $[Ca^{2+}]$ and irradiance compared to sites preferred by *U. intermedia*. Judging from upper or lower limits of ecological factors found *U. ochroleuca* may be considered to be the more tolerant species. It follows from these results and from data in the literature that both species are ecologically very plastic, tolerant of a wide range of various factors. Both species may grow together at one microsite, but only rarely do they do so. Therefore, the differences in stand factors measured probably cannot account for the segregation of sites by these species. The reasons for the segregation may be based on the water régime at particular sites, competition between the species, and/or competitive interactions with dominant plants.

Acknowledgements: Dedicated to Dr. Stepán Husák on the occasion of his 60th birthday. The authors are grateful to Dr. Leos Klimes and for valuable comments, Ms. Irena Pípalová, MSc., for statistical processing of data, and Prof. Douglas W. Darnowski and Dr. Jan Kvet for correction of the language.

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New Cultivars

Keywords: cultivar: *Sarracenia* 'Triple Rarity'.

Sarracenia 'Triple Rarity'

Received: 24 December 2000

This plant's peculiar hybrid ancestry is *Sarracenia* (*oreophila* × *jonesii*) × *alabamensis*. The pitcher leaves are 30-40 cm (12-16 inches) tall, and are erect. The leaves are mostly green in overall tone, and have light green venation on the outer surface of the pitchers (see Front Cover). The venation is more prominent on the inner pitcher surface, especially near the pitcher opening. The pitcher lid is held close over the pitcher opening, and is weakly undulate. The best leaf development is in the late summer and fall. The flower petals are mostly bright crimson, but in areas can be washed with cream color.

In order to maintain the character of this cultivar, it should be propagated vegetatively.

I developed this cultivar in October 1993. I coined the name October 2000. The cultivar name notes that the three parental plants are very rare in the wild.

—John Hummer • 1705 N. Quebec Street • Arlington, VA 22207-3017 • USA

Figure 1: Jim playing with *Sarracenia*.

Jim Robinson (jimsgarden2001@yahoo.com, 1201 N. Race Ave., Arlington Hts., IL 60004, USA) sent in a photo of himself that Phil Sheridan took (clearly having too much fun!); it may look oddly familiar to those with old copies of National Geographic magazine: This reenacts a photo from a well-known carnivorous plant article in the May 1961 issue of National Geographic. Taken at a Virginia Department of Transportation wetland mitigation site in Greensville County, in June 2001, this is one of the sites where Meadowview Biological Research Station (directed by Phil Sheridan) is restoring *Sarracenia* to its historic range in Virginia. Learn more about Meadowview's initiatives at www.pitcherplant.org.

Lubomir Adamec (adamec@butbn.cas.cz, Institute of Botany, Dukelska 135, CZ-379 82 Trebon, Czech Republic) wrote us about seed set and germination in *Utricularia bremii*: Since 1989, we have been growing outdoors *U. bremii* Heer which was collected from a reed-dominated wetland on Kizhi Island in Lake On'ega, Karelya, northern Russia (62°06'N, 35°11'E). The plants flowered prolifically and could be identified. Although the plants have been reproducing vigorously in our culture they only very rarely flowered and set no seeds. In his famous monograph, P. Taylor (1989) wrote: "The pollen of *U. bremii* is nearly always malformed and probably not functional. Fruits and seeds are unknown and it seems that this species is a vegetative apomict." However, Mr. Howard J. Wu in Bishop, California, USA, was able to observe prolific flowering of these plants from northern Russia in his outdoor culture and even collected many seeds. He sent me back 126 seeds. A greater part of these seeds were kept dry for one week, while the rest were permanently in water. All seeds overwintered in water in a refrigerator at 2 to 3°C. In June, they were allowed to germinate in dystrophic water outdoors under natural light. The first seeds, which were permanently in water, germinated as early as in one week. After 37 days, 42% of the seeds kept permanently in water germinated, while 27% of the temporarily dried seed germinated. Germination resulted in healthy seedlings. Thus, evidence has been given that *U. bremii* can give rise to viable seeds. It would be no less interesting to observe what are germination conditions of other temperate aquatic bladderworts such as *U. vulgaris*, *U. intermedia*, and *U. minor*. A challenge for carnivorous plant growers and botanists?

Drosera indica from Narrabri, New South Wales

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Keywords: observations: *Drosera indica*, New South Wales (Australia).

Introduction

Over the last two years I have been studying a population of *Drosera indica* near the town of Narrabri, approximately 250 km north of Dubbo. Plants in this population have a few interesting features including a strong fruity smell to the mucilage on the leaves and the development of functionally unisexual flowers.

Drosera indica is a widespread annual sundew found in tropical and subtropical environments on lands bordering the Indian Ocean and extending into southeast Asia (Diels, 1906). The linear leaves are typically 50 to 100 mm long, lack stipules, and are born along an erect to trailing stem up to 200 mm long. The white, pink or rarely orange-petalled flowers are borne on a one-sided raceme, and produce an abundance of ovoid seed with a scrobiculate (minutely pitted) surface. There are a number of forms and variants within the species, including plants with hooded, red stamens and seeds with an anatomizing sulcate surface; a diminutive form with leaves only 20 mm long; and a form with relatively broad leaves with stalked marginal glands along the entire margin (Lowrie, 1998). From herbarium study, two centers of diversity within the species can be inferred, i.e. northern Australia and Indochina. Many of these forms have been recognised by earlier authors and often described as separate species or varieties (e.g. Planchon, 1848; Mueller, 1855 and Bentham, 1864). Perhaps *Drosera indica* is best viewed as a species complex until an overdue taxonomic revision is conducted?

The Narrabri Plants

The *Drosera indica* site near Narrabri, 30°12'S, 149°29'E, occurs in the sandy creek bed of an ephemeral stream. The sundew grows in shallow depressions, often between 60 and 100 cm above the surface of temporary pools, under a canopy of the reed *Phragmites australis*. Plants were seen actively growing and flowering in March 1999, June 1999, and July 2000.

Drosera indica at this site is remarkably uniform in appearance and has an overall yellow-green colour. The erect to scrambling stems grow to 150 mm tall and are typically 2 mm diameter. They have a remarkably well-developed root system. The linear leaves reach 100 mm long by 3.5 mm wide and have weakly recurved margins, with long-stalked retentive glands along the full leaf margin (see Figures 1, 2). Internode length increases up the stem. The lowermost leaves appear to be borne in whorls of three then become distinctly alternate. Upon reaching maturity, racemes are produced opposite every third to fifth leaf. These are up to 150 mm long, weakly ascending to horizontal, carry between three and twelve flowers, and extend beyond the leaves. Narrowly triangular bracts are produced near the base of every second to third flower. Each bloom is held on a terete pedicel typically 6 mm long, however the basal first or second flower(s) may have pedicels 15 mm long. Each flower has five sepals and five white petals. The sepals are lanceolate; typically 4 mm long by 1.5 mm wide, and have a weakly glandular hairy-dentate apex.

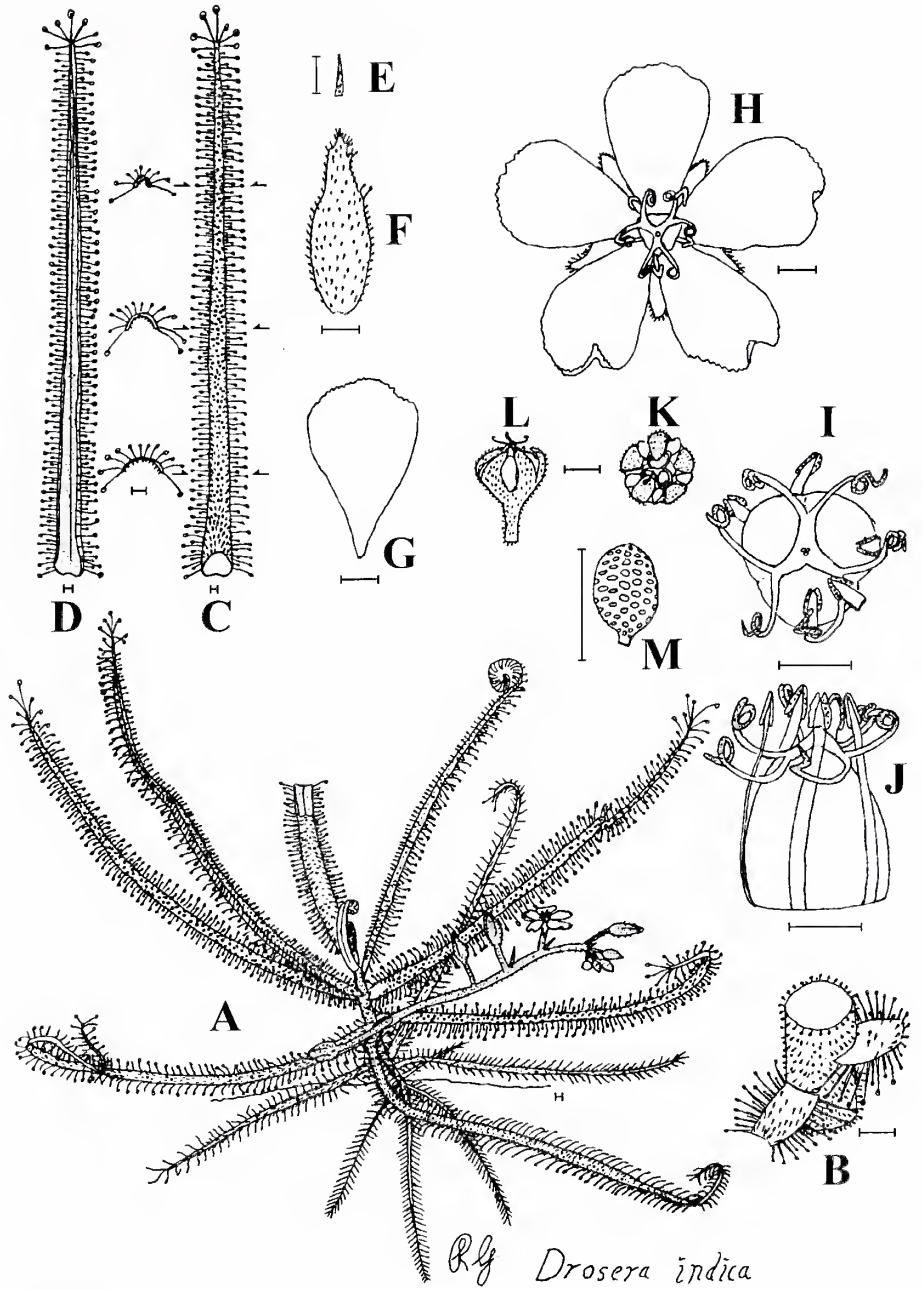

Figure 1: *Drosera indica* from Narrabri drawn from live, cultivated specimens. A: Entire plant; B: close up of a section of stem showing retentive gland arrangement at the base of two leaves; C: leaf upper surface; D: leaf lower surface; E: bract; F: full- sized sepal; G: full-sized petal; H: open flower from above; I: ovary, styles and stamens from above; J: ovary, styles and stamens viewed from the side; K: functionally female flower from above; L: functionally female flower from the side; M: mature seed. Note the three cross sections of the leaf in C and D. Scale bar = 1 mm.

Figure 2: Typical *Drosera indica* from Narrabri.

Figure 3: *Drosera indica* from Narrabri with functionally female flowers.

Figure 4: Functionally female flowers on *Drosera indica*.

The fully formed petals are obovate, 5 mm long and 3 mm wide. The ovary is olive green, glabrous, ovoid to conical, 2 mm tall by 1.4 mm diameter and surmounted by 3 styles, which are bifid from the base. Each style segment is approximately 2-4 mm long, with the apex often strongly reflexed. The five stamens are borne on white, flattened filaments up to 2.5 mm long. Flowers have the ability to self-pollinate. Each produces approximately 200 ovoid seeds. The terete stem, leaf under-surface, peduncle, pedicels, sepals and bract upper surface are covered in short-stalked retentive glands. This variant strongly resembles *D. indica* var. *robusta* of Bailey (1913).

A study of herbarium specimens at the New South Wales and Queensland State Herbaria has shown that *D. indica* plants with leaves of comparable width and distribution of long stalked peripheral retentive glands have been collected at several locations across Australia, particularly in ephemeral wetlands in arid regions. In addition I have observed similar plants, with pink-petalled flowers, beside an ephemeral creek near the town of Leinster, 27°51'S, 120°41'E, in the Western Australian desert. Germination had been triggered by local flooding. Lowrie (1998) has an illustration of a very similar plant that was growing in the town of Cue, which is only approximately 250 km from Leinster (see his Figure D on page 183). The plants at both Leinster and Narrabri had the characteristic sweet, fruity smell emanating from sticky secretions from the retentive glands; this feature may promote the attraction of flower-visiting, flying insects. This character has been noted by Australian aborigines who have used this sundew as a bush food by either sucking the sweet, sticky fluid directly from the leaves or soaking the entire plant in water, and then consuming the sweet drink (Latz, 1995: page 162).

Both filament and petal lengths may vary within and between plants in the population at Narrabri. Typically the flowers have petals which are longer than the sepals and filaments that are as long as the ovary so that, as the flower closes, pollen may be easily transferred from the anthers to the stigmatic surface thus facilitating autonomous self-pollination. During my visit to the site in July 2000 plants with consistently unusual flowers were seen amongst those with typical blooms. These unusual plants had poorly developed greenish petals, only 2 mm long by 1 mm wide, which were held against the ovary by strongly incurved sepals (see Figures 3, 4). The stamens were on filaments up to 1 mm tall and were concealed by the sepals. These flowers were not seen to open further, in the wild or in cultivation, and appeared to be functionally female. Seedlings with both types of flower were brought into cultivation and grown for five months. In some plants the petal length and filament length remained short in all subsequent flowers produced. These flowers were unable to self pollinate autonomously, and set no seed in cultivation. However, the flowers produced on other plants had petals and filaments that increased consecutively in length per raceme, until reaching a maximum, stable size. When collected in July, this variant had petals which scarcely exceeded the sepals and anthers held below the styles and was bearing fruit. When collected in July, this variant had petals which scarcely exceeded the sepals, the anthers were not long enough to reach the styles. Meanwhile, some of the older flowers were already ripening into fruit. Then, seed production halted until spring when the filaments on extant flowers had longer filaments. Due to the brief period of time that the flowers were open none were artificially pollinated. Thus the viability of pollen and receptiveness of styles on the succession of flowers could not be tested.

Another unusual feature seen in cultivated plants was the development of growing points from the base of bracts on the raceme. Each of these formed a small rosette with leaves up to 5 mm long, without discernable internodes. None formed independent plants and all died with the raceme.

Discussion

Variation in filament and petal length is likely to influence the attractiveness of flowers to possible pollinators, male function (i.e. pollen donation) and the breeding system of the plants in this population (e.g. Vaughton & Ramsey, 1998). Flowers with larger petals are likely to be more visible, and thus attractive to potential pollinating insects. Larger flowers are likely to have readily accessible anthers and subsequently have the potential both to set seed from imported pollen and also donate it for potential subsequent cross-pollination events. They also retain the ability for autonomous self pollination. In contrast, the flowers with very short petals and filaments are probably less attractive to potential pollinators, have concealed anthers and thus likely reduced male function and lack the ability of autonomous self pollination. However, they have prominently exposed styles, and thus favour the interception of pollen from other plants, i.e. promoting out-crossing.

This species is an opportunistic annual, which has the ability to set a prodigious amount of seed (e.g. if one plant produced five racemes in a season with an average of 8 flowers each, and all of these set seed, then this plant could potentially produce $5 \times 8 \times 200 = 8000$ seeds), which are typically long-lived. The changing floral morphology and thus breeding system of some plants in this population during the flowering season may have a genetic advantage. The almost universal occurrence of out-crossing individuals early in the season guarantees the production of high quality, and possibly low quantity seed. Perhaps to counter the risk of possible local extinction, the species develops the potential to produce a larger quantity of low quality self-pollinated seed towards the end of the growing season: from the plant's perspective it is better to delay genetic quality control in order to guarantee long-term survival. This mixture of separate functionally female and hermaphroditic flowers within a population is termed gynodioecy, which has hitherto been unreported for *Drosera*.

Further field studies and cultivation trials appear warranted to fully document the change in filament and petal length over the growing season, and noting the fertility of each form. It would be interesting to know if this feature occurs within other populations of this form, or indeed any other *Drosera*.

In conclusion the study of *Drosera indica* plants from the nearby site at Narrabri, in the wild and in cultivation, has led to some puzzling observations on changing petal and filament length in the flowers of successive scapes during a growing season and between plants over time. These have raised questions on the breeding system of the population, and have led to speculation on why this phenomenon occurs.

Acknowledgements

I wish to thank the directors and staff at the State Herbaria of New South Wales and Queensland for study access to the collection.

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Cold *Pinguicula* in a Hot Climate

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Keywords: Cultivation: *Pinguicula*.

If a terrarium-bound carnivorous plant were sentient, what it would think? How would it feel to learn that just a few leaf-lengths beyond the glass walls of its enclosure, a harsh and deadly environment ruled? Like a traveller in a spaceship, it relies upon a life-support system to transform a cruel landscape into a hospitable habitat.

The life-support systems horticulturists devise can create magical results. I have managed to grow carnivores in the hot, arid Sonoran desert of the USA's southwest. In this land, months pass without rain. For weeks, summer temperatures hover near 46°C (115°F). The sun burns deep into the gravel-floored desert. Animals exposed to the heat desiccate into leathery chunks that look like discarded winter hats. Yet in this environment I was able to grow boreal *Pinguicula*, and grow them well!

Figure 1: *Pinguicula leptoceras* halfway through a growing season.

Boreal *Pinguicula* are native to cold climates and require frigid winters to survive. During the cold season, these plants rest as tight buds called hibernacula (singular: hibernaculum). This dormant period can last many months—some of my plants from near the arctic circle rest for nine months of the year! If grown continuously and without seasonal variation, these plants would die within a year.

If you live in a non-arctic climate, growing boreal plants may appear difficult. How can you keep your greenhouse cold enough during the summer, and how can you artificially extend the winter to such a long period? If you grow plants indoors in terraria, your task may seem even greater since terraria are usually maintained year-round without seasonal variations—how could you possibly maintain a plant which absolutely requires seasonal changes? Worry not, for with just a few tricks, boreal carnivores are very easy plants to grow. The principle device you need to grow boreal plants is a little space in your refrigerator, for it is there your plants will rest during their dormancy.

Caring for these plants during their growing period is easy. Boreal *Pinguicula* species are not very large, so 5 cm (2 inch) pots are appropriate. I keep my plants in a 50/50 silica sand/peat moss mix. Their pots stand in purified water all the time, so the soil is moist. The lighting is partial shade—two or four fluorescent bulbs provide enough light. They are not fussy about temperatures during the growing season, anything less than 35°C (95°F) is fine. Fertilizer is not required as the plants usually capture enough fungus gnats to keep them happy (if I were to fertilize them, I would use a foliar spray of Miracid).

Every few weeks I look at the plants and try to detect signs of impending dormancy (Figure 1). If the plants stop producing full-size leaves, and instead form a tightly packed hibernaculum, I know dormancy is near. A few to several weeks after the hibernaculum forms, the summer leaves of the plant rot away, leaving a stringy

muck. Dormancy has arrived!

To prepare these plants for the long winter, I remove any weeds or rotten leaves, and examine the hibernaculum. Tiny lateral buds (gemmae) are often produced by the plant prior to dormancy, and these can be carefully detached and used to start new plants. These can be tiny, less than 1 mm long, so look carefully (Figure 2). I often place tiny bits of white plastic on the soil surface as markers so I do not lose track of these propagules. If I want to repot the plant (which I do every second year or so), this is the time to do it. After this preparation, I store the plant, pot and all, in a sealed plastic bag in my refrigerator. (At this point I note that not only is a refrigerator required, but understanding housemates are also necessary. Remind them that what you have in the refrigerator is not much different from onions or garlic. The nasty peat-filled pots require more creativity to argue around.)

Figure 2: *Pinguicula macroceras* subsp. *nortensis* hibernaculum bearing tiny gemmae.

If you grow your plants in a terrarium, you can encourage your plants to form hibernacula in the fall by decreasing the number of hours your fluorescent bulbs are on. Do not fret about matching the exact number of hours to some desired latitude on Earth, just change the photoperiod to about 75% of the summer value. I change my terraria from sixteen hours to twelve hours.

Once per month, take a look at the contents of each bag in your refrigerator (Figure 3). If you stored a pot that had a few large leaves still attached to some of the plants (an inevitable event when you have several plants in a pot), remove each leaf as it dies.

What you are looking for is the resumption of growth. First the hibernaculum will open—do not take the plant out of the refrigerator yet. Wait another few weeks first. Then return the plant to your growing area and stand back! The first few

Figure 3: Dormant *Pinguicula corsica* hibernacula, not quite ready for growth. Give them another few weeks of cold.

weeks of growth can be amazingly frantic, and you will be astonished at how quickly the hibernaculum will transform itself into a full, growing plant. If you are lucky enough for your plant to flower, it will do it early in the season. Then with surprising brevity, it will drowse back into dormancy. With such a short growing period, these plants may take a few years to reach flowering size, but are lovely little gems even when out of flower.

Now, one final trick for you to try. There is no reason for you to be constrained to grow your plants during the summer. If you store your plants in the refrigerator during your summer, you can grow them during the winter. The plants will never know the difference, and if you grow in a hot climate (as I do), your winter growing conditions may be quite like what your plant is expecting during its summer! It may take a few years to fully shift your plant to growing out of phase, but it is worth it—*Pinguicula* flowers during the winter are marvelously cheery!

Using your refrigerator, you can grow a variety of interesting species like *P. vulgaris*, *P. alpina*, *P. grandiflora*, *P. macroceras*, *P. corsica*, *P. longifolia*, *P. vallisneriifolia*, *P. leptoceras*, and others. Furthermore, the same method works well on the cold-climate *Drosera* like *D. rotundifolia*, *D. filiformis*, *D. stenopetala*, etc. I have even grown *Darlingtonia* and *Sarracenia purpurea* subsp. *purpurea*...all in the hot Sonoran Desert, a few meters from giant Saguaro cacti.

International Carnivorous Plant Society Seed Bank

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Byblis liniflora
Darlingtonia californica
D. californica—Oregon, USA
Dionaea muscipula
Drosera anglica
D. auriculata
D. binata
D. burmannii
D. capensis—narrow leaf
D. capensis—purple flower, narrow leaf
D. capensis 'Albino'—white flower
D. capensis—red
D. capensis—wide leaf
D. capillaris
D. dielsiana
D. dilatato-petiolaris
D. filiformis var. *filiformis*
D. glanduligera
D. intermedia
D. intermedia—giant, Carolina
D. intermedia—North Carolina
D. intermedia—Rhode Island, USA
D. nidiformis
D. rotundifolia—Rhode Island, USA
D. spatulata
D. stolonifera subsp. *stolonifera*
Nepenthes gymnamphora × ?
Sarracenia flava
S. leucophylla
S. minor
S. purpurea
S. rubra
Utricularia multifida
U. violacea

This is a partial list of the seeds available. A complete list is online at the ICPS web site, http://www.carnivorousplants.org/ or by sending a self-addressed, stamped (if USA), envelope to the seed bank address.

Seed packets are US$1 each. Please include US$3 postage and handling for each order. You may pay by cash, check, or money order in US$. Many members pay with cash. Please make checks and money orders payable to "ICPS Seed Bank".

The seed bank is a members-only benefit. The quantity of seed available to each member is 1 packet of each variety per month and 50 packets total in any 12 month period. Please list alternative seed selections, as other orders will arrive before yours. If you have an e-mail address, please include it so we can correspond should any issues arise. Seeds purchased through the seed bank are intended for your personal use only and may not be sold.

The money raised by the seed bank is used by the ICPS to pay for seed bank expenses, web site ISP charges, and ICPS educational and conservation programs. Donate seed and get credit for free seed from the seed bank. Seeds of selected varieties are available free to teachers for use in the classroom and to scientists and conservation organizations. It is ICPS policy not to sell seed of plants protected by CITES Appendix I or the US Endangered Species Act.

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Species/Hybrid Name	Size cm		US $
Cephalotus follicularis, Australia 3 plants	3	H/L	12
Dionaea muscipula (green)	8	L	6
Dionaea muscipula (red) 'Akai Ryu'	8	L	7
Drosera adelae	8	L	6
Heliamphora ionasi, Ilu Tepui., Venezuela	3	H	25
H. minor, AuyanTepui, Venezuela	6	H	15
H. nutans, C. Kukenam, Venezuela	6	H	30
H. tatei, C. Huachamachan, Venezuela	6	H	50
Pinguicula primuliflora	8	L	5
N. alata, Palawan, Philippines	8	L	8
N. albo-marginata, Penang, Malaysia green trap,	8	L	8
N. albo-marginata, Penang, Malaysia all red variety,	8	L	20
N. ampullaria (green), Sarawak, Malaysia	8	L	8
N. ampullaria (speckled), Sarawak, Malaysia	8	L	8
N. argentii, Mt. Sibuyan, Visayas, Philippines	6	H	150
N. bellii, Mindanao, Philippines	8	L	20
N. bicalcarata (red flush), Brunei, Borneo	8	L	15
N. bicalcarata (orange flush), Brunei, Borneo	8	L	15
N. burbidgeae G. Kinabalu, Sabah	8	H	25
N. burkei (to the best of our knowledge) Philippines	15	L	20
N. 'cantley' (N. graciliis x N. bicalcarata), Brunei	8	L	8
N. caranculata, G. Sago, Sumatra	8	H	50
N. clipeata, G. Kelam, Borneo	8	L	75
N. coplandii, Mt. Apo, Mindanao, Sarawak	6	H	50
N. danseri Waigeo Island, Inan Jaya	8	H	30
N. deaniana, Palawan	8	L	15
N. diatus, G. Banadahra, Sumatra	6	H	50
N. distillatoria (yellow/green), Sri Lanka	8	L	8
N. distillatoria (pink), Sri Lanka	8	L	8
N. distillatoria (purple), Sri Lanka	8	L	30
N. eustachya, K. Sembilan, Sumatra	8	L	15
N. faizaliana, Borneo	5	L	20
N. fusca, Sabah	8	H/L	12
N. gracilis , Brunei	15	L	9
N. hirsuta, Sarawak, Malaysia	8	H/L	8
N. 'hookeriana', (N. rafflesiana x ampullana), Brunei	8	L	12
N. insignis, E. Biak, Indonesia	8	L	20
N. khasiana, Meghalaya, India	15	H/L	15

Species/Hybrid Name	Size cm		US $
N. macfarlanei, Genting Highlands, Malaysia	8	H	12
N. madagascariensis, Madagascar	8	L	15
N. mikeii, Sumatra	6	H	50
N. mindanaoensis, (Kurata 2001), Philippines	8	L	20
N. mirabilis, Cape York, Australia	15	L	6
N. mirabilis, var. Echinostoma, Brunei	15	L	20
N. mirabilis, Macau, China	15	L	9
N. murudensis, G. Murud	6	H	35
N. northiana, Bau, Sarawak	8	L	15
N. petiolata, Mindanao, Philippines	5	L	100
N. pilosa, G. Batu Buli, Sarawak	8	H	30
N. rafflesiana, Brunei typical,	12	L	8
N. rafflesiana (elongata), Brunei	12	L	20
N. rafflesiana (gigantea), Brunei	12	L	20
N. rafflesiana x mirabilis var. echinostoma, Brunei	8	L	8
N. rajah, G. Kinabalu, Sabah	12	HH	40
N. rajah, G. Kinabalu, Sabah (4 different clones)	12	HH	120
N. ramispina, Genting Highlands, Malaysia	8	H	20
N. sanguinea, Genting Highlands, Malaysia	8	H/L	12
N. sanguinea, Genting Highlands, Malaysia (4 different)	8	H/L	36
N. sanguinea, Genting Highlands, Malaysia	15	H/L	18
N. sibuyanensis, Sibuyan, Philippines	8	H/L	25
N. spathulata, Sumatra	8	H	25
N. stenophylla, Sarawak	8	H	25
N. thorelli, Phuk Radung, E. Thailand	8	L	20
N. 'trichocarpa', Brunei	15	L	15
N. truncata, Philippines	8	L	20
N. veitchii (highland), Batu Lawi, Sarawak	8	H	25
N. veitchii (lowland), Sungai Samba, Borneo	8	L	25
N. ventricosa, Philippines	8	L	8
N. vieillardii, New Caledonia	8	H/L	20
N. villosa, G. Kinabalu, Sabah	2.5	HH	15
Hybrids			
N. ampullaria x bicalcarata	8	L	12
N. merrilliana x mirabilis (natural hybrid, Philippines)	8	L	8
N. spectabilis x ventricosa	8	L	12
N. ventricosa x inermis	8	L	20
N. veitchii x lowii	8	L	20

HH = 40-50F, H = 50-55F, H/L =60-65F, L = 70F. These night temperatures are suggestions only. You may do well with somewhat different conditions. Humidity: >70% is necessary for most.

Names of Cultivars Registered in 2001

Sarracenia 'Adrian Slack' ; B.Hanrahan & B.Meyers-Rice, Carniv.Pl.Newslett.29:116 (2000) 29 Jan.
Cephalotus 'Hummer's Giant' ; J.Hummer, Carniv.Pl.Newslett.29:119 (2000) 29 Jan.
Drosera 'Marston Dragon' ; A.Slack, Insect-Eating Plants & How to Grow Them:52 (1986) 29 Jan.
Pinguicula 'Aphrodite' ; J.Flisek & K.Pasek, Carniv.Pl.Newslett.29:118 (2000) 29 Jan.
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Looking Back: CPN 25 years ago

Steve Williams unearthed a bit of prose poetry, written by Reginald Farrer in 1908 regarding *Drosera*: "Evil little things they are, with their carnivorous habit. One wonders what crime the past lives of *Drosera* can have held, that now their race should be compelled to draw so ominous and unpleasant a world of murder and fraud. When will Sundews be free of the burden, through some self-sacrificing individual plant who shall starve to death rather than take life, and so redeem his race into happier paths of peace and virtue."

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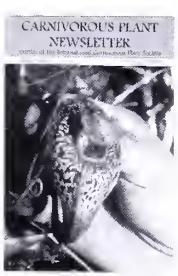

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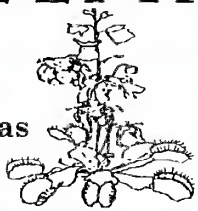

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